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File: ■ Obesity
■ Metabolic Syndrome
■ Type 2 Diabetes

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RE: The Role of Dietary Fats and Oils in the Increase of Metabolic Syndrome, Obesity, and Type 2 Diabetes in Developing Countries

Misra A, Singhal N, Khurana L. Obesity, the metabolic syndrome, and type 2 diabetes in developing countries: role of dietary fats and oils. *J Am Coll Nutr*. 2010;29(3 suppl):289S-301S.

About 60% of the global increase in non-communicable diseases is predicted to occur in developing countries, with most increased mortality from type 2 diabetes (T2D) and coronary heart disease (CHD). Obesity rates in some emerging nations have tripled since 1999, with metabolic syndrome also increasing. Unlike developed nations where most people with T2D are over 64, most with T2D in developing nations are between the ages of 45 and 64. Another issue is a troubling worldwide rise in childhood diabetes. These shifts are linked to modern dietary changes. Refined carbohydrates, high fat intake, red meats, and low-fiber choices are replacing high-fiber, low-fat, and low-calorie foods. Salt and sugar intake also rises with income. In particular, the growing availability of processed commercial vegetable oils boosts higher total fat intake (TFI) and trans-fatty acid (TFA) consumption in developing nations.

Specific fatty acids (FAs) are known to affect cell metabolism. Changes in quantity and quality of fat consumption can alter insulin sensitivity. High TFI is associated with hyperinsulinemia and lower insulin sensitivity. Decreased insulin sensitivity can spark a cascade of events causing T2D. High fat intake is a predictor for impaired glucose tolerance (IGT) in healthy adults and progression to T2D in those with IGT. High fat is also associated with obesity and glucose-insulin metabolic disruption, contributors to T2D.

For this study, data from PubMed, nutritional surveys in developing countries, and websites and publications of national and international groups, including the World Health Organization (WHO) and Food and Agriculture Organization (FAO), were compiled. Much of the focus is on South Asians and Asian Indians, due not only to the authors' interests, but also because more relevant studies have been conducted on these populations than others.

Since the 1960s, TFI as a percentage of total energy (%en) intake has risen in Kenya, China, India, Hungary, Latvia, Brazil, and elsewhere; everywhere data were available, except for the Russian Federation in a sample studied between 1992 and 2000.

Not all obesity is due to modern diets. Traditional diets including whole milk, fats, and oils were associated with risk of abdominal obesity in Mongolian women. Consumption of animal fats has risen in developing countries alongside a drop in consumption in developed nations.

Cost and availability of fats and oils are strong determinants of use in developing countries. For example, olive (*Olea europaea*) oil is expensive and used sparingly. Mustard (*Brassica* spp.), sunflower (*Helianthus annuus*), and soy (*Glycine max*) oils are cheap and are used more widely.

Different fats and fatty acids have specific characteristics. Clinical correlation of these factors with metabolic disorders is attempted. For example, saturated fatty acids (SFAs) are found in oils from coconut (*Cocos nucifera*; 90% SFAs); oil palm (*Elaeis guineensis*), e.g. palm kernel (82%), palm (45%), and palm olein (42%); and in partially-hydrogenated vegetable oils (PHVOs; 24%). Margarine has palmitic acid (a major component of coconut and oil palm products, animal fats, and other plant fats) in varying amounts. Turkish margarine has 7.3-34.3%; Pakistani, 1.9-33.8%. Over 800,000 tons of *ghee* (clarified butter; 65% SFAs) is used annually in India, most in home cooking. It also contains conjugated linolenic acid (CLA), and its role in health needs more study. WHO/FAO (2008) guidelines suggest SFA intake equal to 10%en or less, to keep cholesterol levels in the normal range and reduce risk of CHD.

Polyunsaturated fatty acids (PUFAs), including essential fatty acids (EFAs) *n*-6 linoleic acid (LA) and *n*-3 alpha-linolenic acid (ALA), are discussed at length. Some studies in developing countries have found benefits from consuming more PUFAs as a percentage of TFI. Evidence is stronger for *n*-3 PUFAs – from fish, fish oils, and some plants (flax [*Linum usitatissimum*] seed). WHO/FAO (2008) guidelines recommend PUFA intake of 6-11%en with an average adult requirement of 2%en from LA and 0.5-2%en from *n*-3s. PUFA intake is increasing, ranging from 3.3% TFI in India to 11.3% in Taiwan.

Monounsaturated fatty acids (MUFAs) are found in olive (76%), mustard (70%), almond (*Prunus dulcis*; 69%), and other plant oils. MUFA intake in developing countries ranges from 4.7% TFI in Tanzania to 16.4% in Cameroon. In a small study of Mexican women with T2D, MUFA-rich avocado (*Persea americana*) and olive oil lowered plasma triglycerides more than a diet high in complex carbohydrates. MUFA intake equals TFI minus SFAs, PUFAs, and TFAs, and thus can vary depending on TFI and distribution. According to the authors, it should be 15-20%en.

TFAs, while giving fats longer shelf life, solidity, and stability in deep-frying, also raise low-density lipoprotein cholesterol, lower insulin resistance, and contribute to both T2D and CHD. In some developing nations, TFAs contribute >4%en due to widespread consumption of deep-fried and baked foods. In some Indian baked items, TFA content is 26% of total FAs; in some Iranian foods, 33%. WHO/FAO recommend TFA intake less than 1%en daily. Adverse effects of TFAs from 1-3%en have been seen. In slum dwellers and young people in North India, and nationally in Costa Rica and Brazil, high consumption levels were reported.

Overall, there is a lack of data. There may be population differences in response to intake of different FAs or TFI; some studies have found such differences. Research on the association of TFI and type of fats consumed with metabolic syndrome and T2D in developing countries is urgently needed. Promotion of country-specific guidelines and use of healthy oils is required to halt the burgeoning T2D epidemic.

—Mariann Garner-Wizard

The American Botanical Council has chosen not to reprint the original article.